Structural, electrical and magnetic studies of (1-x) BaTiO$_3$ + x NiFe$_2$O$_4$ ceramic composite: in correlation with electron density studies (MEM)

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Abstract

Magnetoelectric ceramic composite (1-x) BaTiO$_3$ + x NiFe$_2$O$_4$ of nickel ferrite and barium titanate was synthesized with different compositions (x = 0.2, 0.4, 0.6 and 0.8) by solid state synthesis method. The X-ray diffraction (XRD) analysis shows that the prepared composite with the compositions x = 0.2, 0.4, 0.6, 0.8, has only two phases viz; BaTiO$_3$ and NiFe$_2$O$_4$ indicating the well formed composite. Powder X-ray diffraction analysis in the profile refinement method was employed for quantitative phase analysis and structural refinement. The electron distribution and bonding nature of the samples has been analyzed through charge density analysis. Scanning Electron Microscopy measurements were performed to study the surface morphology of the (1-x) BaTiO$_3$ + x NiFe$_2$O$_4$ composite with x = 0.2, 0.4, 0.6, 0.8. The electron dispersive spectra were recorded to analyze the elemental compositions using EDS spectrophotometer. The dielectric response was studied by measuring the variation of the capacitance with frequency. Magnetic measurements of the composite materials were performed using VSM. The hysteresis curves for all the compositions show good saturation magnetization and it increases with the increase in the ferrite content. The electron density studies show that the bonds of the individual atoms are responsible for the electric and the magnetic property of the prepared magnetoelectric ceramic composite.

Key Words: Magnetoelectric composites, Solid State Synthesis, Surface morphology, SEM, Electron density, X Ray diffraction.

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